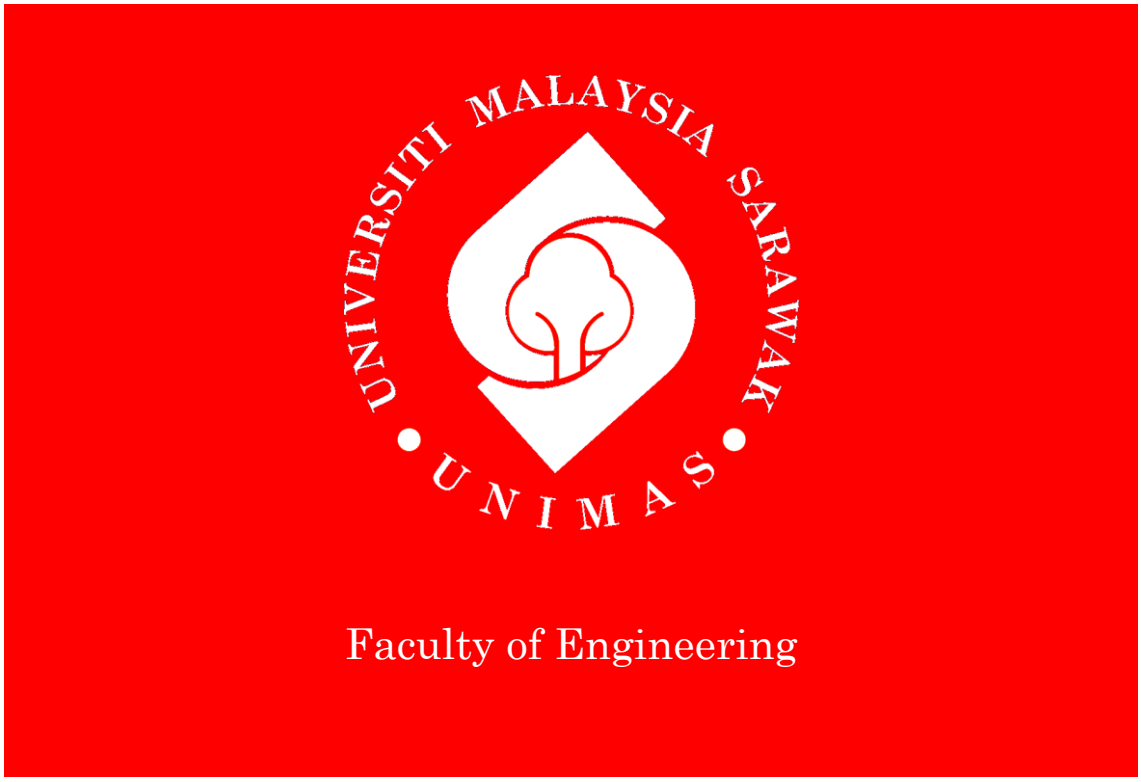

REAL-TIME SMART GAS LEAKAGE DETECTION AND MONITORING SYSTEM USING INTERNET OF THINGS (IoT)

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46027

Bachelor of Engineering (Hons)

Electronics Engineering (Telecommunication)

2017/2018

UNIVERSITI MALAYSIA SARAWAK

Grade: _____

Please tick (√)

Final Year Project Report	✓
Masters	
PhD	

DECLARATION OF ORIGINAL WORK

This declaration is made on the ....19.....day of.....JUNE.....2018

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I SITI NORSHALINA BT MOHD SHAZILI, 46027 FROM FACULTY OF ENGINEERING

(PLEASE INDICATE STUDENT'S NAME, MATRIC NO. AND FACULTY) hereby declare that the work entitled REAL-TIME SMART GAS LEAKAGE DETECTION & MONITORING USING INTERNET OF THINGS (IOT) is my original work. I have not copied from any other students' work or from any other sources except where due reference or acknowledgement is made explicitly in the text, nor has any part been written for me by another person.

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REAL-TIME SMART GAS LEAKAGE DETECTION AND MONITORING SYSTEM USING INTERNET OF THINGS (IoT)

SITI NORSHALINA BT MOHD SHAZILI

Dissertation submitted in partial fulfilment
of the requirement for the degree of
Bachelor of Engineering with Honours
(Electronic Telecommunication Engineering)

Faculty of Engineering
University Malaysia Sarawak

2018

Dear self,

You did it. Be proud.

To my beloved family and friends.

ACKNOWLEDGEMENT

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ABSTRACT

These days, technology has been growing, enhancing and upgrading very rapidly. Wireless communication such an Iot has now extended its roots to almost every possible thing exists around us. This project is about the design and development of Internet of Things (IoT) based real-time gas leakage detection and monitoring system in buildings using Arduino Uno board as a microcontroller, sensors and several other devices with WiFi network connectivity. The project basically shows on how to increase wireless sensor network (WSN) technique by creating new design methods. Thus, from it, the low-cost industrial and home safety level system can be improved. There are several specifications that need to be incorporated and highlight in this project which include gas, flame and temperature sensors, Android, Arduino and WiFi shield module. A notification was used as a method for keep informing users about the system. The system uses programmed Arduino board as a tool to collect input data, process and release it as output data before it can be send to the Android application on mobile users. The notification alarm message will start to display when the collected data is above a predefined threshold. Besides that other components such as liquid crystal display (LCD), light emitting diode (LED) and buzzer are also used a an early warning alarms.

ABSTRAK

Hari ini, teknologi telah berkembang, meningkat dan menaiktaraf dengan kadar yang cepat. Komunikasi tanpa wayar seperti objek rangkaian internet (IoT) telah melebarkan tunjang nya ke arah hampir semua benda di sekitar kita. Projek ini adalah berkenaan tentang mereka bentuk dan penciptaan sebuah sistem yang berkaitan dengan objek rangkain internet dimana dapat memberi amaran awal bagi mengesan dan memantau kebocoran gas dalam bangunan dengan menggunakan “Arduino Uno” sebagai mikropengawal, sensor dan komponen lain dengan adanya sambungan WiFi. Project ini secara am nya menunjukkan bagaimana pengunnaan teknik rangkaian sensor tanpa wayar ditingkatkan dengan mewujudkan kaedah reka bentuk baru. Oleh itu, sistem tahap keselamatan industri dan rumah kos rendah boleh diperbaiki. Terdapat beberapa spesifikasi yang perlu dimasukkan dan diserlahkan dalam projek ini termasuk sensor gas, api dan suhu, modul Android dan modul papan perisai WiFi. Kaedah pemeberitahuan telah digunakan untuk terus memaklumkan kepada pengguna tentang sistem ini. Sistem ini juga menggunakan papan Arduino yang diprogramkan sebagai alat untuk mengumpulkan data input, memproses dan menjadikannya sebagai data output sebelum dapat dikirim ke aplikasi Android kepada pengguna telefon pintar. Mesej penggera pemberitahuan akan mula dipaparkan apabila data yang dikumpul berada di pada atas paras bacaan yang telah ditetapkan. Selain itu, komponen lain seperti paparan kristal cecair (LCD), pemancar cahaya diod (LED) dan buzzer juga digunakan sebagai penggera amaran awal.

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IoT	-	Internet of Things
RX	-	Serial In
TX	-	Serial Out
LPG	-	Liquefied petroleum gas
SSID	-	Service Set Identifier
HTTP	-	Hypertext Transfer Protocol
LAN	-	Local Area Network
GND	-	Ground
AO	-	Analog Output
DO	-	Digital Output

CHAPTER 1

INTRODUCTION

1.1 General Background

Securities issues are the one of issues that we cannot take it for granted and continuously ignore them. Security is actually the indication level of protection against danger and loss. Nowadays, a human is trying to designing our surrounding full of technology and smart system and this is including to provide early warning alert to ensure they have enough time to avoid danger. In designing this project, the main focus sources that have been highlighted are about gas leakage. As you know natural gas is found in almost every home and business area in the world. Even though even the smallest spark can cause a horrific explosion and even the smallest exposure can cause severe medical problems. Gas leak accidents are rare but when it happens, the injuries are often catastrophic and affect large numbers of people. Usually, all gas leak accidents are the result of human error and less of understanding in handling the equipment, especially where it comes to the industrial area and activity.

This main idea of this project is to produce gas leakage detection in the real-time and smart alerting technique. A traditional gas detection system only can check for the concentration levels and give alerts people through audio and visual alarms only. The smart gas leakage detection system does not only alerts people by the audio alarm but also attempts to alert through a call and early notification to the user to more aware of the situation. Along with this project also send the details containing sensor reading that have been recorded at the

time when the alarm got ringing and this detail could be used by a user especially for an organization to make the decision about what kind or type of solution is required in the area of gas leakage.

1.2 Problem Statement

Natural gases such as Liquefied Petroleum Gas (LPG) are usually used in the around the world. LPG is commonly used for cooking in the home. It also has been used in certain gas-based industry since long time ago. Nowadays, the percentage of using natural gases instead of petroleum as the alternative fuel mobile cars has been increased. A procedure for installing LPG-based system is usually very tight but this doesn't make the LPG-system will be facing a gas leakage problem.

In fact, human in real life cannot detect the presence of natural gases using their rough eyes compare to the ability of the sensor. Sensor plays very important role in engineering world as it detects or senses something with very short of time. Thus, the use of gas sensing system is hugely needed to give real-time monitoring of the gas system.

The current gas leakage detection system which already exists and distributed in the market only functions as a gas detector. It only can detect a gas and trigger an alarm that not 100% in real-time. Not only that, the traditional gas detector also has a great precision but still not enough and fulfil the criteria on acknowledging the user about a few factors in the field of alerting people about the leakage and upcoming risk due to it.

1.3 Motivation of the Project

As a future engineer, curiosity is one of nature characteristic one should possess to be able to adapt in this industry as well being able to understand and retain engineering knowledge while utilizing it to the industry's need. As can be seen, the highlight part while doing this project is to understand and gain as much as possible knowledge about Internet of Things (IoT) technology. I am determined to challenge myself to go beyond my own safe zone in order to prepare myself as a competent and efficient engineer.

1.4 Objective of Project

The objectives of this project are:

I. To design a smart gas leakage system that allows the system to give warning in the form of notifications to the users through an android application.
II. To design the real-time and smart gas leakage detector.
III. To design the hardware circuit that allows every user to utilize this wireless indoor safety system.
IV. To test and verify the accuracy of smart gas leakage system.

1.5 Project Outline

Project outline shows the overview of the elements inside every chapter in this which emphasizes the main scope of the chapters. Project outline for final year project report is divided into five chapters which include introduction, literature review, methodology, results and discussion and conclusion and recommendation.

Chapter one reviews the introduction of this project which includes the overview, problem statement, objective and the scope of project.

Chapter two is devoted to literature review where existing studies and researches related to the project obtained from journals and articles.

Chapter three explains about the research methodology. This chapter is the most important part which includes brief explanations for all the methods and techniques use for this project.

Chapter four will discuss all the results and discussion gain from the project. Chapter five will discuss the conclusion and recommendation for this project further improvement and recommendation of this project also will be suggested. This chapter sums up all what have been done and the project's objectives have been achieved.

CHAPTER 2

LITERATURE REVIEW

2.1 Chapter Review

In this chapter, any previous projects, books, journals and paper that have related to this project will be discussed. Those works have been reviewed carefully to get more idea and on understanding this project concept. Not only that, from there, the information gain can be extracted and used in order to improve the quality and reliability of this project. The result of the analysis from the previous project can be used to identify the strength and the weakness that might exist.

The information that has been gain from the previous project can be used and implemented in designing this project. From that, a proper plan on how this project can be done and conducted and the features that have to be added to make this project can highlight on market. There are also some findings from internet and books which are very helpful to this project. Throughout the analysis at the beginning of the project, the special feature in this project is determined and the components used are decided. In the nutshell, the function and the concept are well understood**.**

2.2 Gases

Natural gas is formed from the decomposition organic matters were usually from ancient marine, microorganism, and deposited over the past 550 million years. The process begins when this organic material mixed each other such as mud, silt and sand on the seafloor. This mixture gradually becoming buried over time and sealed off in an oxygen-free environment and exposed to increasing amounts of heat and pressure. This organic matter experiences the process of thermal breakdown and this finally converted it into hydrocarbons.

Natural gas is a mixture of low molecular-weight aliphatic (straight chain) hydrocarbon compounds that are gases at surface pressure and temperature conditions. At pressure and temperature conditions of the source reservoir, the occurrence of a free gas (bubbles) or dissolved in either crude oil or brine might be happened. While the primary constituent of natural gas is methane (CH4), it may contain smaller amounts of other hydrocarbons, such as ethane (C2H6) and various 4 2 6 isomers of propane (C3H8), butane (C4H10) and the pentane (C2H12), as well as trace amounts of heavier 3 8 4 10 5 12 hydrocarbons [1]

2.2.1 Health

Methane is not toxic below the lower explosive limit of 5% (50000) ppm). However, the presence of methane at high concentrations can make it act as asphyxiants. Asphyxiants displace oxygen in the air and cause symptoms of oxygen deprivation (asphyxiation). The available oxygen should be at least 18% or harmful effects will result. Methane displaces oxygen to 18% in the air when present of 14% (140000 ppm) [1]. Table 2.1 below shows effects of oxygen deficiency to a human body.

Table 2.1: Effects of oxygen deficiency to human [1]

Percentage of Oxygen Deficiency	Effects
12-16%	• Breathing and pulse rate are increased • Slight muscular incoordination
10-14%	• Emotional upsets • Abnormal fatigue from exertion • Disturbed respiration
6-10%	• Nausea and vomiting • Inability to move freely • Collapse • Possible lack of consciousness
Below 6%	• Convulsive movements • Gasping • Possible respiratory collapse • Death

Leakage and subsequent combustion of natural gas also release large amounts of water vapour, ashes, volatile organic compounds and toxic fumes into the atmosphere [2]. This kind of particulates and substances can pass through the human respiratory system and bring about respiratory diseases. Natural gas is lighter than air and therefore rises up, concentrating nearer to the human head. Due to this, symptoms such as pneumonia, nausea, vomiting, irregular breathing, fatigue and headache are also reported because of the exposure to natural gas leaks in lower concentrations.

2.2.2 Environment/ Disaster

Gases such as Methane AND LPG are structurally mixture of carbon and hydrogen (CH) compound. Therefore, when the gas is combining with oxygen in a balance concentration, it will turn into a flammable gas. The Flammable Range is the range of a concentration of a gas or vapour that will cause a burn or explode if an ignition source is introduced. Thus, all the gas mention above easily flammable when exposed to an ignition source. The fire that causes by gas will more easily explode and contribute to serious property damage and serious injury or death to the human.

2.3 Research

In process to generate more ideas regarding this project, there are several journals which have related gas leakage detection have been reviewed. All of them have the same basic concept which is detected by using some sensors, and this can be controlled by the microcontroller and the final output for the system is give a warning or alert to the users. The information gain from these previous projects was collected and analysed carefully and being combined in order to help complete this project.

2.3.1 Gas Leakage and Smart Alerting and Prediction Using Internet of Things (IoT)

The journal about this project is written by Asmita Varma, Prabhakar S, and Kayalvizhi Jayavel from SRM University Kattankulathur, Chennai. Their project is about to design the gas leakage detection and smart alerting and prediction using IoT. This device is suitable for use in home, industry or plants that use LPG and natural gas in their operations.

Basically, they are using IoT concept for and apply to the gas leakage system so that this system has the ability involving calling, sending a text message and even an e-mail to the concerned authority. This project is using Arduino Uno as a microcontroller so that when the gas sensor is connected to this board for processing the sensor readings following the setup program. Not only that, to make this module have the ability to do such of smart technique as mentioned before this, the GSM module and Ethernet shield also been using as a main component. This module is connected to Arduino board which helps in making calls and

sending text messages when the sensor value is above the threshold while the Arduino Ethernet Shield could allow an Arduino board to connect to the internet.

The processing steps are started when the MQ-2 Gas Sensor detects the concentration of gases. Pre-heat must be done before in order to make the sensor reading stable enough. The best preheat time for a MQ-2 sensor is 24 hours. When the sensor is exposed to the unusual value of gas concentration, buzzer will be actuated and values are updated on a cloud platform. An email about the details containing the concentration levels of gases is sent to the concerned authority. Lastly, the call to the fire station or ambulance will be made as soon as the gas leakage detected. If the sensor readings are about reach the lower explosion limit (LEL), the relay will cut off the power supply to the main switch. Figure below shows how the gas leakage detection processing steps.

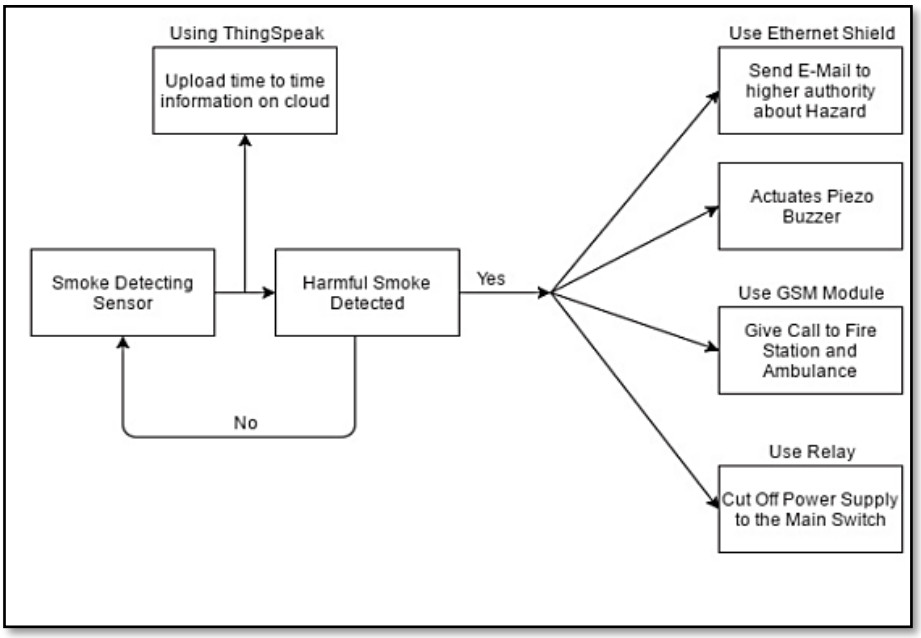

Figure 2.1 : Gas leakage detection processing steps [1]

2.3.2 Automated Leakage Detection and Control a Life Saviour

The journal is written by R.Sreenidhi from Electronics and Instrument Department, Sri Sairam Engineering College, West Tambaram, India. This project is about designing automated gas leakage detection that has the ability to takes an automatic control action after detection of LPG leak 0.001%. [4]. This kind of automatic control action provides the closing